Chapter 5.0 National Criteria Pollutant Estimation Methodologies

5.1 WHAT INFORMATION IS PRESENTED IN THIS CHAPTER?

This chapter provides a list of the source categories in the National Emission Trends (NET) data base whose emission estimation methods have changed since the December 1997 *Trends* report and the years that were affected by the methodology changes. It also provides a brief description of the revised methods used to estimate emissions from these sources.

5.2 WHERE DO I GET INFORMATION ON THE METHODS USED TO ESTIMATE EMISSIONS FOR SOURCES WHOSE METHODS DID NOT CHANGE?

To obtain information on how emissions were estimated for sources not listed in this chapter, you should look in the *Trends* Procedures Document.[1] The *Trends* Procedures Document can be obtained on the Internet using the following website address:

http://www.epa.gov/ttn/chief/ei_data.html#ETDP

In addition to the *Trends* Procedures Document, you should also look at the chapter entitled "Methodologies That Are New" and Appendix B of the *Trends* update document.[2] Methods used to estimate emissions for several source categories were changed last year, and descriptions of the changes are found in the "Methodologies That Are New" chapter of that report. The *Trends* update document can be found on the Internet using the following website address:

http://www.epa.gov/ttn/chief/trends98/emtrnd.html

Table 5-1 provides an overview of all sources whose emission estimation methodologies have changed since publication of the *Trends* Procedures Document.

5.3 WHAT OTHER THINGS SHOULD I KNOW ABOUT THE TRENDS ESTIMATION METHODS?

Each year, the United States (U.S.) Environmental Protection Agency (EPA) compiles emission estimates used in assessing trends in the amounts of criteria pollutants discharged into the air. Prior to 1993, the main purpose of the published trends was to portray relative progress in the control of air pollutant emissions nationally. Those estimates were based on standardized emission inventory procedures using aggregate national economic and demographic data. As interest in, and the need for emission figures for individual States and metropolitan areas increased, it was obvious those techniques lacked the precision needed to provide the detailed data, representative of diverse economic and geographic areas, that could realistically assess emission reduction efforts at these smaller scales.

In recent years, the preparation and presentation of national emission estimates has evolved toward meeting the need for more detailed and more accurate inventories. To achieve this goal, revised methodologies have been developed that support the incorporation of detailed State Implementation Plan (SIP) inventories and/or other regional inventories where available (e.g., Ozone Transport Assessment Group [OTAG], Grand Canyon Visibility Transport Commission [GCVTC], periodic emission inventories [PEI]). In addition to presenting national progress in reducing air emissions, local trends in emissions are now presented when possible.

> *Because of these changes in methodologies, comparison of values with previous **Trends** reports is not a valid exercise. You should use caution when comparing estimates for the years 1985 to 1997 from this report with values in any previous report.*

Table 5-2 provides a general overview of where emission values were obtained for each State, for both point and area sources. Mobile source emissions are estimated by EPA for all States using the MOBILE model. EPA also prepares utility emission estimates. Table 5-3 indicates the source of

data for the two most important pollutants emitted by utilities (nitrogen oxides [NO_x] and sulfur dioxide [SO_2]).

5.4 WHAT SOURCE CATEGORIES ARE ESTIMATED USING METHODS THAT DIFFER FROM THE PREVIOUS REPORT?

Table 5-1 provides a synopsis of the sources whose methods have changed since the publication of the last *Trends* report.[1] Some of the sources listed in Table 5-1 were updated during the preparation of emissions for the *Trends* update[2] and were described in the "Methodologies That Are New" chapter and Appendix B of that report. The shaded rows in Table 5-1 indicate source categories that were modified this year and are described in the sections of this chapter that follow.

5.5 HOW WERE EMISSIONS FROM NON-ROAD SOURCES ESTIMATED?

One of the major changes in the methods used to estimate emissions this year was for non-road sources. EPA's Office of Transportation and Air Quality (OTAQ, formerly the Office of Mobile Sources [OMS]) has been working on a model that estimates the emissions from these sources for several years. The April 1999 draft version of the NONROAD model was available for use this year in estimating emissions from this source category (**http://www.epa.gov/otaq/nonrdmdl.htm**).

In large part, emission estimates for volatile organic compounds (VOC), NO_x, carbon monoxide (CO), SO_2, particulate matter (PM) less than 10 microns (PM_{10}), and PM less than 2.5 microns ($PM_{2.5}$) were calculated using the draft version of the NONROAD model, for all gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG) nonroad equipment types at the 10-digit Source Classification Code (SCC) level. There were a few categories that were not calculated using the NONROAD model. The methods used to calculate emissions for those non-road sources are described in section 5.5.4 and 5.5.5. In addition, the NONROAD model does not contain emission factors to calculate ammonia (NH_3) emissions. As a result, NH_3 emissions were calculated outside the model using fuel consumption estimates that were generated from the NONROAD model. The methods used to calculate other pollutants that are not included in the NONROAD model are described in section 5.5.6.

5.5.1 What Types of Sources are Included in the NONROAD Model?

The NONROAD model includes the following general categories:

- agricultural;
- airport support;
- light commercial;
- construction and mining;
- industrial;
- lawn and garden;
- logging;
- pleasure craft;
- railroad; and
- recreational equipment.

The model generates emissions at subcategory levels lower than the general categories listed above. The subcategories are equivalent to 10-digit SCC levels.

5.5.2 What Years Were Estimated?

County-level criteria pollutant estimates for non-road sources were prepared for all years from 1985-1998 inclusive. National emission estimates were calculated for 1970, 1975, and 1980.

5.5.3 Were There Differences in the Methods Used to Calculate Non-road Emissions for Different Years?

Yes. EPA calculated county-level emissions differently for the periods 1985-1995, 1996, and 1997-1998. The methods used to calculate county-level emissions for 1985-1995 and 1997-1998 were identical. Two different methods were used due to time and budget constraints.

EPA calculated criteria pollutant emission estimates for 1996 using the draft NONROAD model adapted to run on a DEC Alpha UNIX workstation. A set of 385 input files was prepared in order to produce an annual county-level non-road emissions inventory for 1996. These input files included a default input file for each State that accounted for average statewide temperatures and seasonal (summer, fall, winter, and spring) Reid vapor pressures (RVP). Emissions for all counties in the United States were calculated using the default State input files. In some cases however, the estimates for particular counties were replaced with county-specific estimates, if those counties had significant differences in their RVP, fuel characteristics due to reformulated gasoline (RFG) and oxygenated fuel requirements, and Stage II controls.

For areas subject to Phase 1 of the Federal RFG program, separate RVP values were modeled in the 1996 NONROAD inputs for May through September. Oxygenated

fuel was modeled in the areas participating in this program in 1996. Four seasonal emissions files for each run were then added together, and the records for each State were combined to produce a database of annual and daily emissions.

Ozone season daily emissions were also estimated. Weekday or weekend day emissions must be specified separately when running the NONROAD model (i.e., annual and daily emissions cannot be generated during the same runs). Because of the time involved in preparing county-level estimates for the whole nation, daily emissions were estimated by using the summer season emissions generated by the NONROAD model, divided by 92 days rather than performing an additional set of calculations for weekday or weekend day emissions.

Emissions for 1985-1995 and 1997-1998 were calculated differently than 1996 emissions. The NONROAD model was run at the national level for all relevant inventory years. Each national run included three seasonal (i.e., summer, winter, fall/spring combined) NONROAD model runs per year to estimate annual criteria pollutant emissions. Seasonal runs were performed to account for differences in average seasonal temperature, as well as RVP. Fall and spring were combined since the average seasonal temperature for those seasons is generally equivalent.

Using the results of the national-level runs, we calculated a ratio by dividing national 10-digit SCC-level emission estimates for each year by their equivalent 1996 national values. County-level emissions were estimated for each year by multiplying each ratio times the 1996 county-level, SCC-level emissions. This approach ensures that the sum of all county-level emissions for any year are equivalent to the national-level estimates, but are distributed to the counties according to the 1996 distribution. This approach was utilized due to time and resource constraints.

Because the NONROAD model estimates growth in local equipment populations using one national average growth rate, the effects of growth should be reflected in the national-level runs for each alternate year aside from the base year 1996. The effects of federal non-road emission standards in future years (e.g., years beyond 1996) would also be accounted for. Because the model uses one average growth rate for the whole nation, the approach of using the 1996 county-level inventory as a basis for geographically allocating national inventories for other years was assumed to be reasonable. However, temperature and fuel inputs to reflect local conditions cannot be accounted for when doing a national-level run for a specified year.

As a quality assurance step, category-level emissions generated from the 1996 county-level NONROAD model UNIX runs and summed to the national level were compared with emissions resulting from 3 national, seasonal runs (summer, winter, fall/spring combined). Fall and spring seasonal runs were combined to save resources, since the temperatures for these two seasons are generally similar. This was also done to test the viability of the proposed approach for other years, which rely on national-level runs geographically allocated to the county-level using the 1996 county distribution. If a large disparity existed in the results obtained when running the model at the county-level versus the national level, it could also potentially result in a discontinuity in the emissions data from 1996 to 1997, or from 1995 to 1996. The results of these two separate runs are, in fact, reasonably comparable.

Revised emission estimates were also calculated for 1970, 1975, and 1980. Only national estimates are available for these years. We determined source category-specific ratios of the updated 1985 estimates to the previous Trends values. We then multiplied that ratio times the previous national Trends non-road value for each year to develop revised estimates.

5.5.4 Were There Non-road Emission Sources That Were Not Estimated Using the NONROAD Model?

Yes. Emissions for recreational gasoline powered equipment, aircraft, commercial marine vessels, and locomotives were estimated using other methods. EPA has determined that the draft version of the NONROAD model over estimates the equipment population for recreational gasoline powered equipment, so emissions for that category were estimated using the Trends methods used before introduction of the NONROAD model. For the other non-road emission sources, the NONROAD model does not currently include estimation methods for these categories, so the current Trends method found in the *Trends* Procedures Document was used to develop the emission estimates.[1]

5.5.5 How Were Emissions Estimated for Categories Discussed in Section 5.5.4 Above?

As indicated above, the NONROAD model is still in draft form, and emission estimates for certain categories are still undergoing review. For example, large populations are reported for recreational gasoline equipment. This results in emission estimates that are significantly higher than prior year estimates. For this reason, EPA requested that emission estimates from the existing Trends data base be used in place of the NONROAD model estimates for this category.

Commercial aircraft and general aviation estimates for 1997 and 1998 were developed from 1996 values using updated landing-takeoff operations data from the Federal Aviation Administration (FAA) as growth factors. Military aircraft, unpaved airstrips, and aircraft refueling emissions were grown from 1996 using growth factors consistent with the current draft version of the Economic Growth Analysis System (EGAS).[3] Information on how the 1996 emission

estimates for these sources were developed can be found in the *Trends* Procedures Document.[1]

EPA's OTAQ prepared 1995-1998 VOC, NO_x, CO, and total PM national emission estimates for commercial marine diesel engines. PM_{10} was assumed to be equivalent to PM, and $PM_{2.5}$ was estimated by multiplying PM_{10} emissions by a factor of 0.92. These new national estimates were distributed to counties using the geographic distribution in the existing 1996 NET data base [i.e., the National Acid Precipitation Assessment Program (NAPAP) distribution, or the State-supplied distribution, if a State had submitted data under OTAG for these categories]. Commercial marine emissions were not reported under the same SCC for all States in the data base. For example, some States reported commercial marine diesel emissions under the SCC 2280000000, which could potentially include other fuel types (e.g., residual, gasoline). Therefore, a distribution was established based on emissions for all commercial marine SCCs. Because the OTAQ estimates included emissions from residual-fueled vessels, emissions corresponding to this SCC were removed, as well as emissions from the general SCC 2280000000. Sulfur dioxide emissions reported for residual-fueled vessels were not removed, however, since OTAQ did not supply revised emissions for this pollutant.

In addition, records for several States had emissions for some pollutants, including SO_2 and PM_{10}, but no VOC, NO_x, or CO emissions. We estimated the emissions for these pollutants, by using a national average ratio of VOC/PM_{10}, NO_x/PM_{10}, and CO/PM_{10} which were calculated from the available inventory data. These ratios were then applied to the PM_{10} emissions to estimate the missing VOC, NO_x, and CO emissions.

For the years 1985-1994, we calculated the ratio of the 1995 revised OTAQ commercial marine emissions to the previous 1995 Trends emissions values for each pollutant. This ratio was then applied to emission estimates for the following SCCs: commercial marine diesel (2280002), commercial marine residual (2280003), and commercial marine unspecified fuel (2280000). This method was used to avoid a large disparity between existing Trends estimates and revised OTAQ estimates (which were only available back to 1995). We did not perform any additional data augmentation for these years.

1997 and 1998 emission estimates for commercial gasoline, commercial coal, and military marine vessels were grown from 1996 using growth factor values that were consistent with the current draft version of EGAS.

5.5.6 Were Any Pollutant Estimates Prepared Differently for Non-road Sources?

Yes, lead (Pb) and NH_3. Pb was estimated using methods described in section 5.18 of the *Trends* Procedures Document.[1] For NONROAD model categories, NH_3 emissions were calculated for the years 1990-1998, based on county-level fuel consumption estimates obtained from NONROAD model runs. Fuel consumption estimates were not available for LPG and CNG-fueled equipment. Emission factors provided by EPA's OTAQ were then applied to these activity data to estimate NH_3 emissions for gasoline equipment (without catalysts) and diesel-fueled equipment. The emission factors were derived primarily from light-duty on-road vehicle emission measurements, and extrapolated to nonroad engines on a fuel consumption basis.

As indicated above, emission estimates for recreational gasoline equipment were maintained from the previous version of the NET. However, recreational gasoline NH_3 emissions were calculated differently. Recreational gasoline equipment NH_3 emissions were calculated based on the NONROAD model fuel consumption estimates. These estimates were then redistributed to existing NET records. This was done to avoid having records in the inventory that only contained NH_3 estimates, since many of the SCCs reported in the NONROAD model for this category were not present in the existing Trends inventory. In addition, many States had previously reported these emissions under the general SCCs 2260001000 (all 2-stroke gasoline recreational vehicles) and 2265001000 (all 4-stroke gasoline recreational vehicles), instead of the more specific recreational equipment types.

For aircraft, commercial marine, and locomotive categories, national fuel consumption estimates for 1996 were obtained from various sources. Jet fuel and aviation gasoline consumption for general aviation and commercial aircraft were obtained from the "FAA Aviation Forecasts Fiscal Years, 1998-2009."[4] For aircraft categories, NH_3 emission factors developed for diesel engines were applied to all fuel consumption estimates, since aviation gasoline consumption was determined to be relatively small compared to jet fuel, and the aircraft SCCs are not defined by fuel type. Diesel consumption estimates for locomotives were obtained from "Locomotive Emission Standards - Regulatory Support Document (RSD)."[5] For commercial marine, data for distillate and residual fuel oil were reported in "Fuel Oil and Kerosene Sales."[6]

To develop NH_3 emissions for 1997 and 1998, 1996 base year NH_3 emissions for these categories were projected for these categories using growth factors. SO_2 emissions were not supplied by OTAQ for commercial marine and locomotives, and estimates for this pollutant were projected using growth factors as well. NH_3 emissions were reported in the NET database for commercial marine and locomotive categories for historic years (i.e., 1990-1995); no changes were made to these historic estimates. Historic NH_3 emissions were not available for aircraft, so there is a disparity between 1995 and 1996 for NH_3 emissions for this category.

Once annual NH_3 emissions were calculated, summer season daily emissions were estimated using seasonal profiles

available from the 1985 NAPAP study. SCC-specific summer seasonal fractions were applied to the annual emissions to generate summer season emissions, which were then divided by 92 days to estimate summer season daily emissions.

5.6 WHAT CHANGES WERE MADE IN THE METHOD USED TO ESTIMATE NONUTILITY POINT AND AREA SOURCE EMISSIONS?

EPA has tried over the last several years to ensure that the NET data base reflects State developed emission estimates whenever feasible. For example, 1990 NET emission estimates include State-developed data from OTAG and GCVTC inventories. Emissions for years following 1990 were supplemented with data from the Aerometric Information Retrieval System (AIRS). PEI and annual submission of emissions data for major point sources are required under the CAAA. As part of the PEI requirements, States containing nonattainment areas (NAAs) needed to submit a PEI for 1996. Consequently, one of EPA's goals was to include data developed by the States as part of the 1996 PEI effort in the NET. While the CAAA only requires submittal of ozone pollutant data for the PEI requirements, annual point source reporting is designed to cover all pollutants. Additionally, in the guidance provided to the States on the PEI submittal process, EPA encouraged States to submit emission estimates for all pollutants, since the NET contains estimates for all criteria pollutants and is to be the ultimate repository of the State data. To reduce the burden of preparing this inventory, EPA gave each State a copy of the 1996 NET inventory as a starting point in preparing their 1996 PEI.

In the past, EPA has estimated emissions for this group of sources by growing emissions using growth factors derived from the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). As mentioned above, some data derived from AIRS was also used to supplement the emissions in certain years.

5.6.1 What Steps Were Required to Incorporate State PEI Data Into the NET?

The incorporation of the 1996 State/Local emission inventory data is a five step process:

- Data Collection;
- Quality Control (QC);
- Data Augmentation;
- Quality Assurance (QA); and
- Data Loading.

In the data collection step, EPA solicited PEI and annual point source data from the States. There were four acceptable formats States could use to submit their data: 1) the NET Input Format, 2) through AIRS/AIRS Facility Subsystem (AFS), 3) the Electronic Data Interchange X.12 format, and 4) the NET Overwrite Format.

In the QC step, EPA evaluated the data received to ensure that States had correctly characterized, on the 1996 Emission Inventory Submittal Form, the data they submitted (e.g., geographic coverage, pollutants, SCCs, annual and daily emissions), that the data were formatted correctly; that mandatory data elements were included, and the priority SCCs needed to incorporate the data were present (e.g., nonutility point and stationary area source SCCs). Any problems found were followed-up by a phone call to the State/local agency for review and resolution. If basic problems could not be resolved, the data were not included in this version of the NET. Data not included in this version of the NET will be incorporated in FY 2000.

In the data augmentation step, data elements required for the regional scale modeling or this report, that were not supplied in the State data set, were added to the NET. EPA needs a complete inventory containing VOC, NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, and NH_3. We added emission estimates to the NET for any of these pollutants if they were not included in the State submitted data. Each data element was characterized as "mandatory submission" or "data can be augmented." As part of the QC step, all data received was checked to ensure that data elements classified as mandatory submission were included in the data supplied by the States.

In the QA step, data were checked for reasonableness. QA reports highlighting questionable data were developed and sent to the States for review. Questionable data were either confirmed by the State as correct, corrected by the State, or in the case where the State did not respond, replaced using the data augmentation methods. The QA reports that were sent to States for review included:

- Tier 2 Summary;
- Top 20 Plants for Each Pollutant with Comparison to Current Data;
- NET Plants Not in the State Data;
- Geographic Coordinate Exceptions;
- Stack Parameter Exceptions; and
- Large Sources Without Emission Controls.

In the data loading step, EPA loaded State data that met the QA criteria, or was resolved during the QA step, into the NET data base. This resulted in a fully revised 1996 point and area source file.

5.6.2 How Many States Submitted Data for the 1996 PEI Effort?

Point source data for 34 States and area source data for 13 States was received as part of the PEI data incorporation effort. Figure 5-1 is a map of the United States that indicates which States provided 1) point source data that were utilized, 2) point source data that were not utilized at this time due to data quality problems, 3) point and area source data that were utilized, and 4) no data.

For the majority of States, the PEI point source submittals were made to the AFS. Some States submitted data in alternative formats, primarily using the NET Input Format.

5.6.3 Were Any State-Supplied Data Rejected in the QC Phase?

Yes. A few States' data were rejected either due to problems with data completeness, data format, or both. EPA is working to resolve these problems with the individual States and hopes to include data from these States in the next release of the NET. These States are indicated in Figure 5-1 as States whose data will be processed in 2000.

5.6.4 What Types of Data Were Augmented in the Data Augmentation Step?

As mentioned above, the NET contains emission estimates for all criteria pollutants (except Pb). Thus data elements and/or pollutant emissions that were missing in the State provided data needed to be augmented. The data augmentation procedure included augmenting information related to stack parameters (height, diameter, velocity, flow, temperature), location information (latitude and longitude), operating schedule (hours per day, days per week, hours per year, seasonal throughput), and emission estimates for pollutants not included in the State submittals. A detailed list of the items augmented in the data augmentation phase and the individual steps taken to augment the various data elements is provided in Barnard et. al.[7] and in the draft *Trends* Procedures Document currently being revised.[8]

5.6.5 What Quality Assurance Steps Were Taken to Ensure That the State Data Were Incorporated Correctly?

Quality assurance was an essential element of the data incorporation process. Extensive internal review of the data was performed to ensure that the data were retrieved and formatted correctly and that the data augmentation process was performed correctly. On-going reviews were made of the data to ensure that there were not duplicate records, that emissions values were not "out of range", and that the values for stack parameters were within normal operational values.

The most important part of the QA program was State review of the retrieved and augmented data. EPA prepared a review package for each State submitting data. The review package consisted of a number of reports and tables showing a variety of information about the preliminary data set.

In the past, QA of the NET inventory focused almost exclusively on the emission estimates. Due to the NET's change in focus to a modeling inventory, QA of the NET was expanded to cover additional data elements including stack parameters, geographic coordinates, emission control data, and operating schedule data.

To QA stack parameters, upper and lower limits were developed for each stack parameter carried in the NET. The Stack Exception Report in the QA package listed stacks in the NET where one or more of the parameters was above the upper bound or below the lower bound. High and low values not corrected by the States were replaced with the corresponding upper or lower bound value. The acceptable ranges for each stack parameter are listed below:

Height	0 ft to 1,250 ft
Diameter	0 ft to 50 ft
Temperature	32°F to 2,250°F
Velocity	0 ft/sec to 650 ft/sec

To QA geographic coordinates, maps were generated for each State showing any facilities that were located outside of their State borders when plotted using the geographic coordinates supplied by the State. Coordinates not corrected by the States were replaced with the coordinates for the county centroid based on the State and county codes provided by the State.

5.6.6 What Did EPA Do With Comments Received by the States?

In the early review of the data, several States indicated that the emissions for their ozone precursor pollutants were not correct. The original downloads from AFS were designed to retrieve the default emissions value. However, several States indicated that they typically stored emissions data in one of the alternative emission fields. As a consequence, EPA surveyed the States that submitted data to determine which States submitted emissions data in something other than the default emissions field. Data for those States was retrieved a second time and augmented as required. The emissions for those States were re-summarized and sent back to the States for a final review.

Once comments from all of the review packages were received, modifications to the emissions or process data were made based on the State comments. Modification to the AFS PEI data were made to reflect either new data from the

additional downloads, modifications based on the review packages sent out to the States, or based on data that remained anomalous (e.g., stack flow rates).

One portion of the State review package was a list of plants not included in the PEI submittals that were in the version of the 1996 NET provided to the States as a starting point for PEI preparation. Several States provided comments on that table indicating that 1) some or all of these facilities should be maintained, and 2) indicating that while they should be maintained, the emissions should be modified to reflect more accurate State-supplied values. The data for these plants were extracted from the NET and maintained in a separate file. Since the review packages only provided plant totals, ratios of old to new plant emissions were used to adjust the values of each segment's emissions and then the data were updated in the file.

5.6.7 Was There Any Additional Data Augmentation?

Yes. In addition to criteria pollutants, the NET also houses estimates of NH_3 emissions. None of the States submitting PEI data submitted NH_3 emissions. As a consequence, the NH_3 emissions from the 1996 NET needed to be added back into the revised data base. Two steps were taken to perform this augmentation. First, plant-level total NO_x emissions were calculated for the PEI data submitted by the States. Then plant-level summaries of NH_3 from the NET were developed. Where a match could be made using the State Federal Information Processing Standards (FIPS) code, county FIPS code, and plant identification (ID) code, segment-level emissions for NH_3 were calculated using the following equation:

$$NH_3seg = (NO_xseg/NO_xplant) * NH_3plant$$

where:

NH_3seg	=	segment-level NH_3 emissions
NO_xseg	=	PEI segment-level NO_x emissions
NO_xplant	=	PEI plant-level NO_x emissions
NH_3plant	=	NET plant-level NH_3 emissions

In order to maintain the NH_3 totals currently in the NET, NH_3-only plant/segment-level records were added for those facilities that did not match plants in the PEI submitted data.

5.6.8 Were There Emissions From Any Sources Submitted by the States That Were Not Incorporated into the NET?

A few source categories were not updated using State-supplied PEI data. These source categories were not updated because EPA feels that the consistent methodology and the quality of the data involved in the calculation of emissions from these categories is at or above that provided by the States. For point sources, State-supplied utility emissions data for segments with SCCs beginning with 101 were not retained. For area sources, the categories not included from State data were on-road mobile and non-road. This approach will be revised in 2000, as data issues are resolved between the States and EPA for the utility and mobile categories.

5.6.9 How Were Nonutility Point and Area Sources for 1997 and 1998 Developed?

The PEI data incorporation effort was only for 1996 emissions. Thus, EPA had to develop 1997 and 1998 emissions internally. Emissions for nonutility point sources and many area sources were developed using growth factors.

To develop 1997 and 1998 emission estimates, EPA compiled a set of emission growth factors to apply to the 1996 NET inventory. For the most part, these growth factors were developed using procedures that are similar to those used by EGAS.[3] The current, publically available version of EGAS is version 3.0. Because EGAS version 3.0 was released in 1995, EPA has recently been working to develop an EGAS Version 4.0. The growth factors used for developing 1997 and 1998 estimates were developed using the draft version of EGAS 4.0. As part of the EGAS version 4.0 development effort, EPA has obtained more recent data/models and updated some of the underlying EGAS files. Two of the major changes that EPA has been performing are: (1) incorporating new economic models from Regional Economic Models, Inc. (REMI); and (2) revising the EGAS 3.0 crosswalk that is used to assign REMI model-derived growth factors to SCCs. The REMI models, which included 72 modeling regions in EGAS 3.0, cover the continental United States. While many modeling regions cover an entire State, some States have separate models for ozone NAAs and rest-of-state areas. For this effort, updated REMI models were available that provide historical (through 1996) and forecast (through 2035) socioeconomic data for each of 75 modeling regions in the United States (three new modeling regions were added in North Carolina).[9] As part of the revisions to the EGAS 3.0 crosswalk, EPA reviewed each of the previous SCC assignments and incorporated new assignments for over 2,600 additional SCCs.

The EPA applied REMI model-derived growth factors to point sources at the Standard Industrial Classification (SIC) code-level whenever SIC code information was available in the inventory. Because REMI's models provide output for 172 economic sectors, which are roughly equivalent to 3-digit SIC codes, REMI output was first directly matched to the SIC code information available from the point source component of the NET inventory. For some point source records, SIC code information was missing, available at less than a 3-digit SIC code level, or invalid (did not represent a valid SIC

code). For these point source records, EPA assigned REMI model-derived growth factors to SCCs using the revised EGAS crosswalk. Because the REMI models do not include Alaska and Hawaii, it was necessary to utilize a different source of projections data for these States. The BEA released a set of gross State product (GSP) projections in 1995.[10] These projections, which are generally available at a 2-digit SIC code level, were used to develop growth factors for Alaska and Hawaii. The BEA-derived growth factors were first matched with point sources in the inventory at the 2-digit SIC code level. For point sources with missing/invalid SIC code information, and for all area sources, EPA matched BEA data with emission sources using an updated EGAS 3.0 crosswalk matching BEA sectors with SCCs.

EGAS 3.0 includes a number of models that project energy consumption by sector and fuel type (e.g., residential natural gas consumption). The revisions to the energy consumption modules in EGAS 3.0 have not yet been completed. Because these updates are expected to include the use of Department of Energy (DOE) energy projections data, EPA compiled the DOE's forecast data for use in adjusting the REMI/BEA data for projected changes in energy intensity.[11] Specifically, the EPA calculated the following national energy intensity factors for 1996, 1997, and 1998:

- Residential fuel combustion - projected delivered energy by fuel type divided by projected residential floor space;
- Commercial/institutional fuel combustion - projected delivered energy by fuel type divided by projected commercial floor space; and
- Industrial fuel combustion - projected delivered energy by fuel type for both specific industries (e.g., refining industry) and for total industrial fuel use divided by projected constant dollar industrial output (specific industry or total industrial output).

Next, EPA calculated the ratios of national 1996 energy intensity to both the national 1997 and 1998 energy intensity for each sector/fuel type. For residential natural gas consumption, for example, EPA developed 1996:1997 and 1996:1998 ratios of residential natural gas consumption per square foot of residential floor space. These ratios were then used to adjust the EGAS modeling region-specific REMI/BEA population-based residential fuel consumption growth factors.

Finally, for VOC emissions, controls were implemented for several maximum achievable control technology (MACT) sources. If a source category was subject to MACT in either 1997 or 1998, the 1996 control efficiency for that source was compared with the control efficiency that the MACT control would have on VOC. If the 1996 control efficiency was greater than or equal to the MACT control efficiency then the data was maintained at the 1996 level. If the 1996 control efficiency was lower than the MACT standard, then uncontrolled emissions were back-calculated using the 1996 control efficiency and then controlled emissions were calculated from the uncontrolled levels using the MACT control efficiency. The MACT control efficiency value was also inserted into the data base field for control efficiency. It was assumed that the MACT controls operated for the entire year, even if they were not scheduled to come on-line until the middle to latter part of the year.

5.7 WHAT OTHER METHODOLOGY CHANGES WERE THERE?

Methodology changes or changes in the underlying data used to calculate emissions were made for agricultural livestock, structural fire, and prescribed burning emissions. In addition, corrections were made in how on-road mobile NO_x emissions were calculated to account for the heavy-duty NO_x defeat device on heavy-duty diesel engines. (See Section 5.7.4.)

5.7.1 What Changes Were Made in How Agricultural Livestock Emissions Were Calculated?

EPA had calculated PM and NH_3 emissions from agricultural livestock sources using U.S. Department of Agriculture (USDA) Census of Agriculture data on animal populations. The Census of Agriculture is conducted every 5 years. Thus, we had been required to develop a methodology that could be used to estimate emissions in years between the publication of the Census of Agriculture data. EPA used BEA State-level farm sector growth factors to estimate emissions for the years between Census of Agriculture publications. For the time period that EPA had estimated emissions from this source category (1990-1997) only one Census of Agriculture publication had been prepared (1992). The 1997 Census of Agriculture was released in the spring of 1999. An evaluation of the actual statistics on livestock populations following release of the 1997 Census of Agriculture indicated that the livestock population data for 1997 was very similar to the 1992 data. However, the NET inventory had shown approximately a 25 percent drop in total NH_3 emissions from 1992 to 1997 which was due almost entirely to an approximately 40 percent drop in emissions in the livestock category. Apparently agricultural commodity prices dropped between 1992 and 1997, but livestock populations stayed more or less stable. Since the BEA statistics use commodity prices rather than animal population data, the post-1992 inventories would be underestimated.

Thus EPA decided that the emission estimates for this source category should be revised using more appropriate data

on animal populations. The 1987 Census of Agriculture data were obtained and in conjunction with the 1992 and 1997 data a linear estimation method was developed to predict animal populations for intermediate years and to project to 1998. The linear estimates developed were State and animal specific. In some cases, development of the linear regression used to estimate animal populations resulted in negative values. In those cases, the animal population was set to zero.

Using the revised animal population data with the current emission factors[1], revised estimates were developed. The changes only affected NH_3 and PM emission estimates.

5.7.2 What Changes Were Made in How Structural Fire Emissions Were Calculated?

EPA has an on-going program to improve the quality of emission estimates. That program, the Emission Inventory Improvement Program (EIIP) routinely evaluates the methods used to estimate emissions from various sources. Recent work by the EIIP had identified a revision to the loading factor used to estimate emissions from structural fires. The revised value for the loading factor was obtained from the California Air Resources Board.[12]

Using the revised loading factor, emission estimates were revised starting with 1990. Since several States submitted data for this source during the OTAG data collection process, revised and updated 1990 emission estimates for this source were developed by EPA only for non-OTAG States. Once the 1990 estimates were revised, 1991-1995 estimates were calculated by using a growth factor developed for the on-going revision to EGAS. The growth factor for the revised version of EGAS was developed using a regression equation that relates national population to the amount of material burned in structural fires. State-level population is then used as an input to predict the amount of material burned in each State, using the regression equation. Both OTAG and non-OTAG estimates were grown.

Estimates for 1996 were developed using updated activity data and the California Air Resources Board's loading factor for non-OTAG states. OTAG States were grown using the EGAS growth factors. Then, as part of the 1996 PEI data incorporation effort, 1996 emissions were replaced by State-supplied data obtained during the PEI effort.

Estimates for 1997 and 1998 were developed identically to how the base 1996 data were developed, except that there was no replacement with State-supplied data, since there was no equivalent to the PEI data for those years.

5.7.3 What Changes Were Made in How Prescribed Burning Emissions Were Calculated?

EPA updated prescribed burning emissions estimates to better reflect data now available with which to calculate growth in this sector. In earlier versions of the NET, emissions for prescribed burning were grown using population as a surrogate. EPA felt that population was not an appropriate growth surrogate for prescribed burning. A method developed for the Section 812 Prospective[13] study which held private land acreage constant, but develops a growth index for public lands based on national statistics for acres burned, was initiated this year. The technique uses 1990 estimates as a base year, since values for 1990 include actual data for a number of States, especially those in the GCVTC inventory.

EPA used information on the fraction of public including State-owned and private land from the Section 812 Prospective study to allocate a portion of the emissions to each of these components. Then, a national ratio of acres burned on public lands was developed using U.S. Forest Service data.[14] Growth factors were then developed by calculating a ratio for the year of interest relative to 1990 (the base year). The growth factor was then multiplied by the fraction of emissions attributable to public lands. This value was then added back to the remaining emissions (i.e., those attributable to private lands) to obtain the emissions for each year. This is a rough estimate. The actual number of acres burned each year varies greatly and is a function of fuel moisture, fuel density, meteorology, and other factors.

5.7.4 How Did EPA Account for Emissions from Heavy-Duty Diesel Engines that Used the NO_x Defeat Device?

On October 22, 1998, EPA reached a settlement agreement with seven manufacturers of diesel truck engines. EPA had found that the engines in as many as 1.3 million trucks built over the last 10 years had devices that defeated pollution controls. Those allegations were related to excessive NO_x emissions during highway driving that were not occurring during engine certification testing. The engine electronic control module would switch to those fuel-efficient, but high NO_x, operation modes during highway driving. Federal officials considered such engine control software "defeat devices", which are illegal under the federal laws.

For purposes of this report, a defeat device is a vehicle component or software which allows excess emissions to be produced during operating modes which are not explicitly covered by a certification test while still controlling emissions during the certification test. In the case of the heavy-duty NO_x defeat device, the device was active (shut off emission control

systems) during steady-state operating modes such as cruising down the freeway, but was mostly inactive during transient operation. It was built into heavy-duty diesel vehicles (HDDVs) beginning in the 1988 model year, and completely removed by the 2000 model year. In the late 1980's and early 1990's the defeat device was being phased into the fleet and was mostly confined to the heavy end of the heavy-duty diesels (8a and 8b vehicles). However, by the mid to late 1990's it was widespread on virtually all of the heavy end engines and most of the medium and light end heavy-duty diesels.

EPA's MOBILE model used to calculate emissions from on-road vehicles is designed based on engine certification testing. Thus, the use of the defeat devices by HDDVs caused the emission factors calculated by those models to underestimate emissions from these vehicles. In order to determine that actual emissions arising from the use of these devices, EPA developed a series of spreadsheet models to provide corrected emission factors for heavy-duty vehicles that would account for the underestimated emissions.[15] EPA's OTAQ spreadsheets contain multiplicative factors representing the ratio of HDDV NO_x emissions with the defeat devices to the HDDV NO_x emissions without the defeat devices. These factors differ by calendar year, roadway type, and vehicle speed. The HDDV NO_x emissions, calculated using the MOBILE5b HDDV NO_x emission factors, were revised by multiplying the appropriate factor at the State/ county/roadway type level of detail for the years 1990 through 1998. Additional details on the spreadsheet models can be found at the following website address:

http://www.epa.gov/OMSWWW/m6.htm

5.9 REFERENCES

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14. "Forest Statistics of the United States, 1987," USFS publication, PNW-RB-168, U.S. Forest Service. September 1989.
15. "Development and Use of Heavy-Duty NO_x Defeat Device Emission Effects for MOBILE5 and MOBILE 6," EPA420-P-99-030, U.S. Environmental Protection Agency. October 1999.

Table 5-1. Emission Estimation Methods That Have Changed Since the Last Report

Year of Inventory	Pollutant	Category	Methodology Change*
1990	CO, VOC, NO_x	Primarily nonutility point sources and 17 states worth of area sources	A combination of Ozone Transport Assessment Group (OTAG), Grand Canyon Visibility Transport Commission Inventory (GCVTC), and Aerometric Information Retrieval System (AIRS) data was added to inventory, replacing some units but primarily just adding more units. (Ozone season daily data received was developed into annual data).
1990	PM_{10}, $PM_{2.5}$, SO_2	As above	State data received as above was augmented with PM and SO_2 data through an SO_2 and PM to NO_x uncontrolled emission factor ratio.
1991-1995	All but Pb	Primarily nonutility point sources and 17 states worth of area sources	NAPAP, AIRS data, GCVTC and Grand Canyon projections from the 1990 inventory using Bureau of Economic Analysis (BEA) growth indicators.
1990	All but Pb	on-road mobile	1990, 1995, 1996 use state-supplied MOBILE model inputs where applicable. See Reference 1 for a list of States supplying model inputs.
1990	All but Pb	on-road mobile	Used state supplied vehicle miles traveled (VMT) where applicable. See Reference 1 for a list of States providing VMT.
1985-1989	All but Pb	chemical and allied	Removed rule effectiveness from pre-1990 chemical and allied product emissions.
1985-1994	NO_x	utilities	Used NO_x emission rates from Acid Rain Division (ARD) instead of AP-42 emission factors.
1994-1998	NO_x, SO_2	utilities	Based Phase I units on CEM data from ARD, remaining units are from DOE767 survey data (small amount of units).
1996	All but Pb	nonutility point (35 states) and area sources (14 states)	Added state-supplied data directly received from states or retrieved from AIRS as part of the PEI inventory effort, as directed by the states. 5 State submittals were select cities only.
1997-1998	All but Pb	nonutility point and area sources	Projected through 1998 based on the 1996 PEI enhanced database using EGAS derived growth factors and BEA growth factors where applicable.
1970, 1975, 1980	All but Pb	non-road sources	Generated national-level nonroad emission estimates based on category-specific ratios of 1996 NONROAD model outputs to previous year national estimates.
1985-1998	All but Pb	non-road sources	Ran the beta version of the NONROAD model for all counties in U.S. for 1996. Used the NONROAD model to calculate national emissions for the other years and then used SCC-specific ratios for the other years relative to 1996 (year in question/1996) to determine county-level estimates.
1985-1998	All but Pb	non-road sources	For commercial marine diesel, EPA's OTAQ provided revised national VOC, NO_x, CO, and PM emission estimates for commercial marine diesel engines. National estimates were distributed to counties using the geographic distribution in the existing NET.
1990-1998	All but Pb	Miscellaneous-agric. forestry	Revised allocation of Census of Agriculture activity data between the 1990 and 1997 census: used agricultural surrogates instead of economic surrogates.
1990-1998	PM	Miscellaneous -agric. crops	Began using tillage activity data using the Conservation Technology Information Center, Purdue University, data, and also changed silt value methodology from 1990 onward.
1989-1998	PM	Miscellaneous-managed burning	Based on USDA Forest Service inventory of PM from prescribed burning. Public percentage of acres burned projected from 1990 using national-level growth factor developed from total U.S. acres burned, while private portion held constant.
1990-1998	PM	Miscellaneous -construction	Changed the emission factor in 1990: changed from using a former AP-42 value to using latest AP-42 findings report: "Improvement of Specific Emission Factors" - change occurred in Trends year 1997.
1990-1998	PM	paved roads	The rain correction factor in the paved road equation was reduced by 50 percent for the years 1990 onward due to uncertainty associated with the actual reduction in emissions due to precipitation on paved road surfaces.
1990-1998	All but Pb	structural fires	For non-OTAG States, revised 1990 and 1996 emissions based on new loading factor value. Projected all States using EGAS regression equations, which relate State-level population to the amount of material burned in structure fires.

* For a list of specific data sources used for each State, please see Section 4.1 of reference 8.

Table 5-2. Point and Area Source Data Submitted

	Point Sources		Area Sources	
State	**Source**	**Adjustments to Point Source Data**	**Source**	**Adjustments to Area Source Data**
Alabama	PEI		PEI	Birmingham NAA Only
Alabama	OTAG	Backcast to 1990 using BEA. Average Summer Day estimated using methodology described.	NAPAP	
Arizona	NAPAP		NAPAP	
Arkansas	OTAG	Average Summer Day estimated using default temporal factors.	NAPAP	
California	PEI		PEI	
Colorado	PEI		NAPAP	
Connecticut	PEI		PEI	
Delaware	PEI		PEI	
Florida	PEI		OTAG	Added Non-road emissions estimates from Int. Inventory to Jacksonville (Duval County).
Georgia	PEI	Only Atlanta not statewide	PEI	Only Atlanta not statewide
Georgia	OTAG	Average Summer Day estimated using default temporal factors.	OTAG	
Idaho	NAPAP	PEI data submitted but not incorporated into NET inventory.	NAPAP	PEI data submitted but not incorporated into NET inventory.
Illinois	PEI		OTAG	
Indiana	PEI		PEI	
Iowa	NAPAP		NAPAP	
Kansas	PEI		NAPAP	
Kentucky	PEI		OTAG	
Louisiana	PEI		PEI	
Maine	PEI		OTAG	
Maryland	PEI		PEI	
Massachusetts	PEI		NAPAP	
Michigan	PEI		OTAG	
Minnesota	OTAG	Average Summer Day estimated using methodology described above.	NAPAP	
Mississippi	NAPAP		NAPAP	
Missouri	PEI	Only partial state.	PEI	St. Louis NAA Only
Missouri	OTAG	Backcast to 1990 using BEA. Average Summer Day estimated using methodology described above.		
Montana	PEI		NAPAP	
Nebraska	PEI		NAPAP	
Nevada	NAPAP		NAPAP	
New Hampshire	PEI		OTAG	
New Jersey	OTAG		OTAG	
New Mexico	NAPAP		NAPAP	
New York	OTAG		OTAG	
North Carolina	PEI		OTAG	Average Summer Day estimated using default temporal factors.
North Dakota	PEI		NAPAP	
Ohio	OTAG	Average Summer Day estimated using methodology described above.	OTAG	Assigned SCCs and converted from kgs to tons. NO_x and CO from Int. Inventory added to Canton, Dayton and Toledo counties.

Table 5-2 (continued)

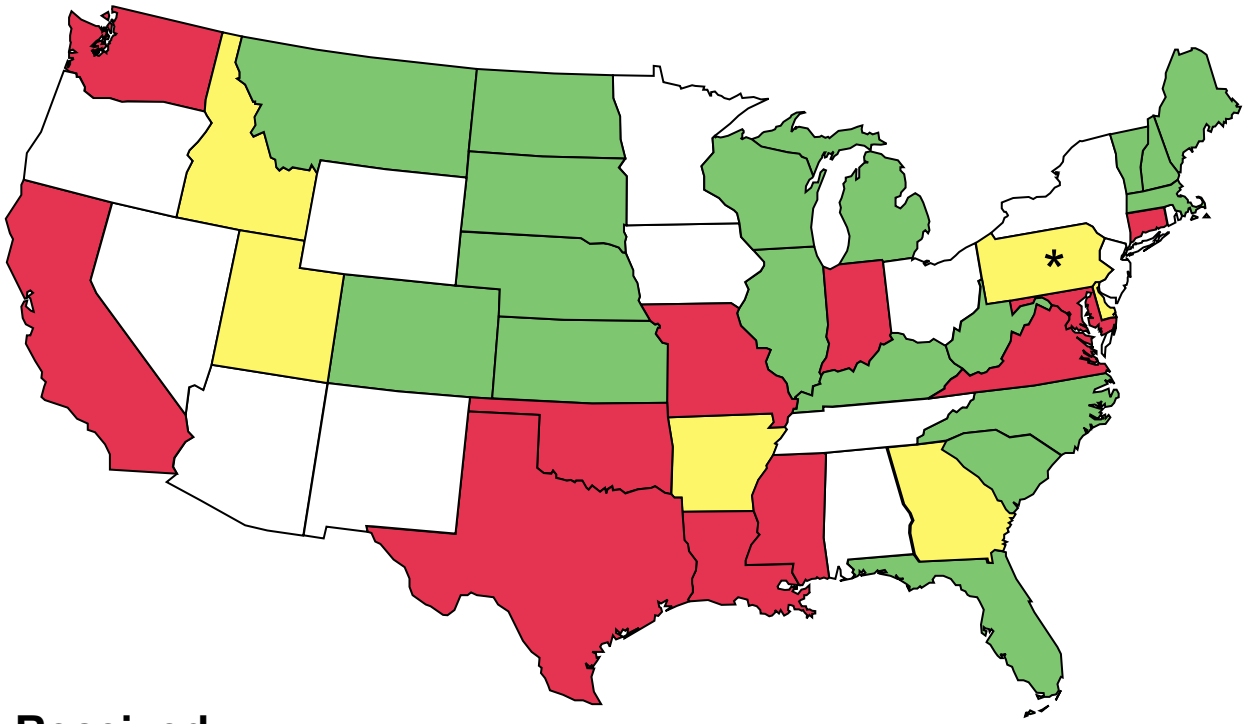
	Point Sources		Area Sources	
State	**Source**	**Adjustments to Point Source Data**	**Source**	**Adjustments to Area Source Data**
Oklahoma	PEI		PEI	
Oregon	GCVTC		GCVTC	
Pennsylvania	PEI	Allegheny and Philadelphia Counties Only	PEI	Allegheny and Philadelphia Counties Only
Pennsylvania	OTAG		OTAG	Non-road emissions submitted were county totals. Non-road emissions distributed to specific SCCs based on Int. Inventory
Rhode Island	OTAG		OTAG	
South Carolina	PEI		NAPAP	
South Dakota	PEI		NAPAP	
Tennessee	OTAG	Average Summer Day estimated using default temporal factors.	OTAG	No non-road data submitted. Non-road emissions added from Int. Inventory.
Texas	PEI		PEI	NAAs Only (Houston, Beaumont, Dallas, El Paso)
Utah	NAPAP		NAPAP	
Vermont	PEI		OTAG	
Virginia	PEI		PEI	
Washington	PEI		PEI	
West Virginia	PEI		OTAG	
Wisconsin	PEI		OTAG	
Wyoming	NAPAP		NAPAP	

NOTE(S): Year of Inventory is 1996 for PEI, 1990 for OTAG and GCVTC, and 1985 for NAPAP

Table 5-3. Utility Boiler Emissions Data Sources for NO_x and SO_2 by Year

Year	NO_x	SO_2
1985	Overlaid Acid Rain Division (ARD) coal NO_x rate calculations when possible	NADBV311 data
1986	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1987	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1988	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1989	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1990	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1991	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1992	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1993	Overlaid ARD coal NO_x rate calculations when possible	Calculated from EIA-767 data
1994	Overlaid ARD coal NO_x rate calculations when possible; overlaid ETS/CEM data when possible	Calculated from EIA-767 data
1995	Overlaid ETS/CEM data when possible	Overlaid ETS/CEM data when possible
1996	Overlaid ETS/CEM data when possible	Overlaid ETS/CEM data when possible
1997	Overlaid ETS/CEM data when possible	Overlaid ETS/CEM data when possible
1998	Grew from 1997 data and overlaid ETS/CEM data when possible	Grew from 1997 data and overlaid ETS/CEM data when possible

Figure 5-1. States Submitting Point and/or Area Source Data for the 1996 PEI



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